Measuring nutrient concentrations and transformation rates at the landscape scale.

Brian Bergamaschi
Bryan Downing
Tamara Kraus
Katy O'Donnell
Nicholas Graham
Jessa Rego
Elizabeth Stumpner
others…

Carol Kendall
Isotope Component

Alex Parker
Phytoplankton Component

Wim Kimmerer
Zooplankton Component

US Geological Survey
California Water Science Center
Biogeochemistry Group

A pilot study to assess the effects of wastewater-derived nutrients on Delta habitats: nutrient concentrations, ratios, isotopic composition, transformation rates and links to the foodweb.

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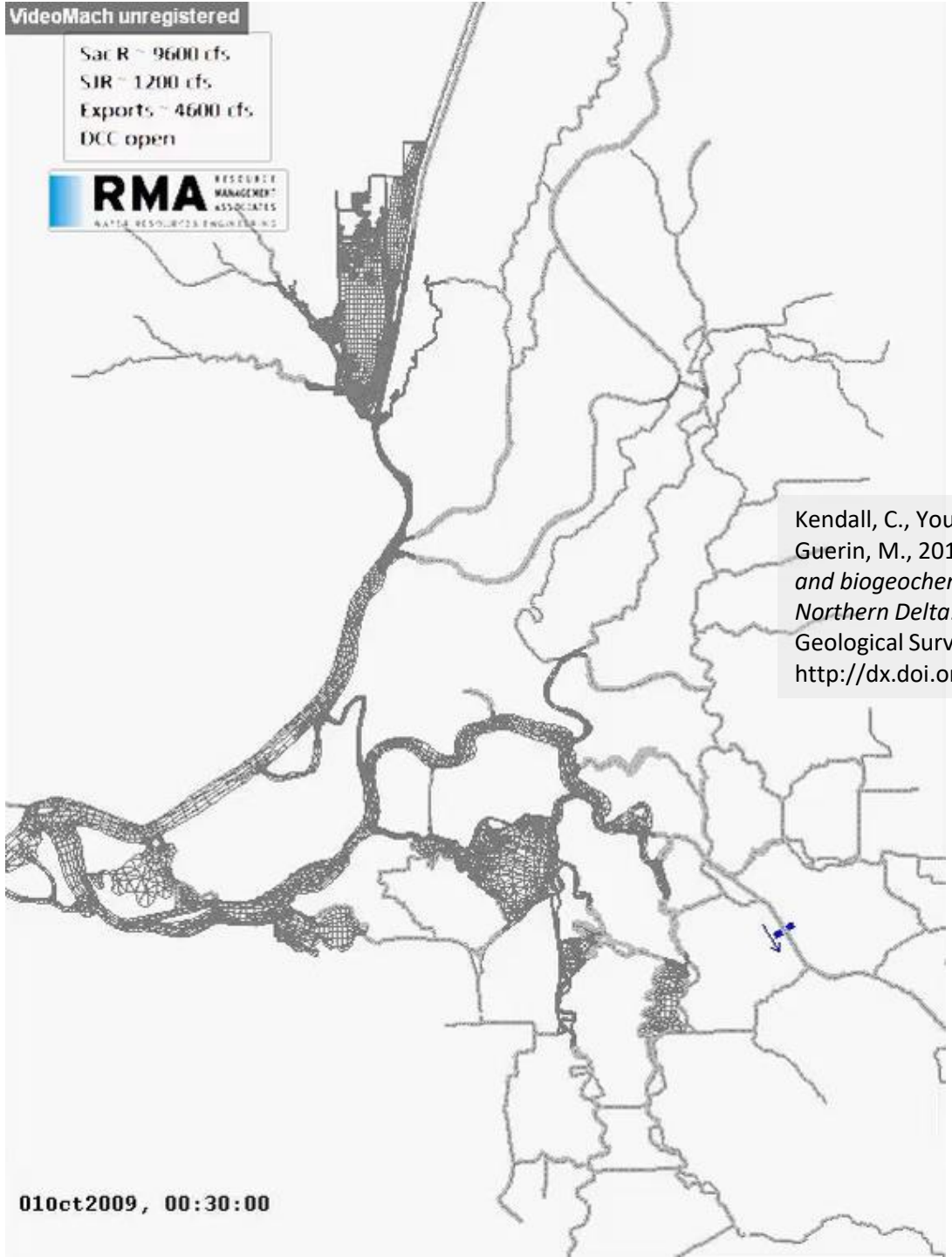
TIME IS A MASTER VARIABLE

$$\frac{dC}{dt} = kC$$

$$C_t = C_0 e^{-kt}$$

(The real world)

$$\frac{dC}{dt} = kCX^{x}Y^{y}Z^{z}$$



Kendall, C., Young, M.B., Silva, S.R., Kraus, T.E.C., Peek, S., and Guerin, M., 2015. *Tracing nutrient and organic matter sources and biogeochemical processes in the Sacramento River and Northern Delta: proof of concept using stable isotope data.* U.S. Geological Survey, Data Release, http://dx.doi.org/10.5066/F7QJ7FCM

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Using Continuous Underway Isotope Measurements To Map Water Residence Time in Hydrodynamically Complex Tidal Environments

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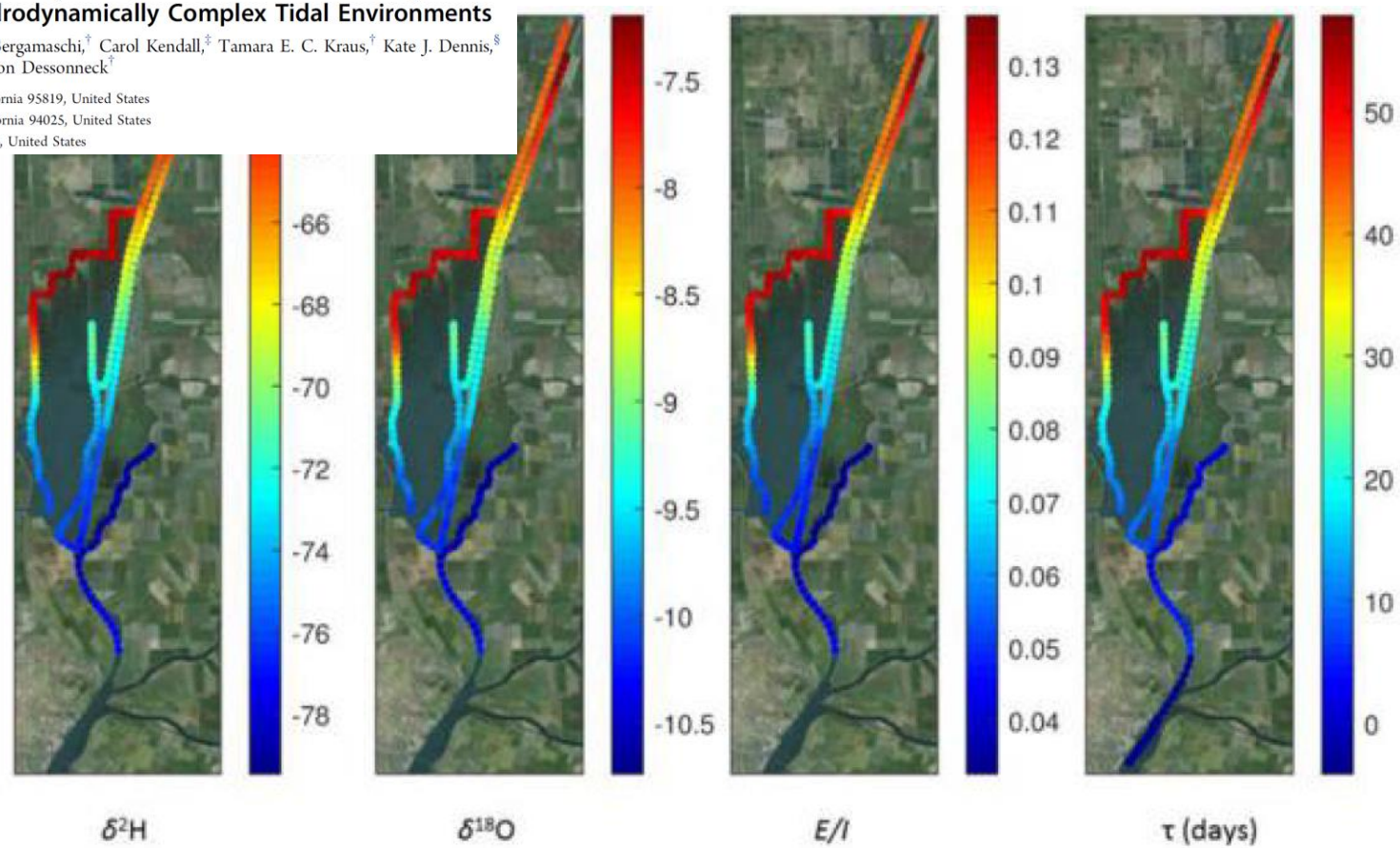
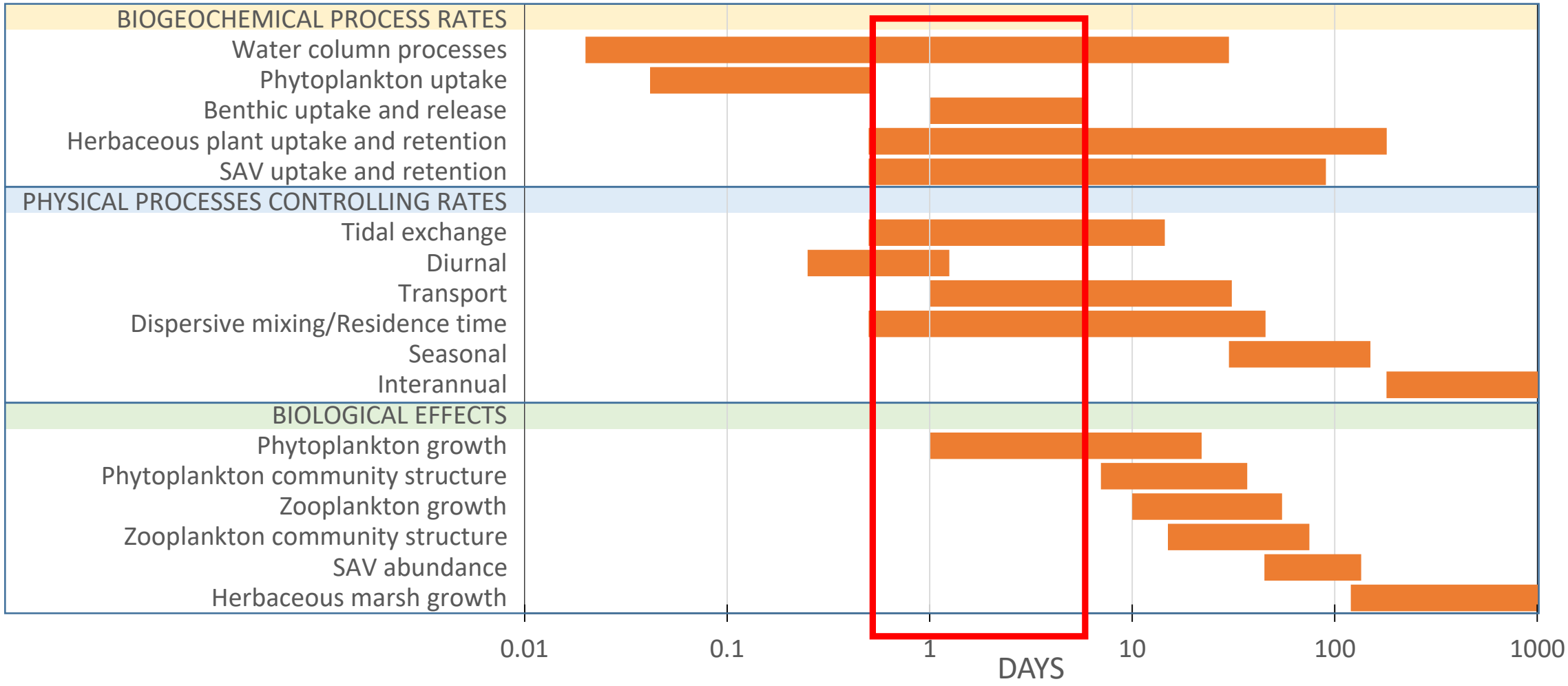
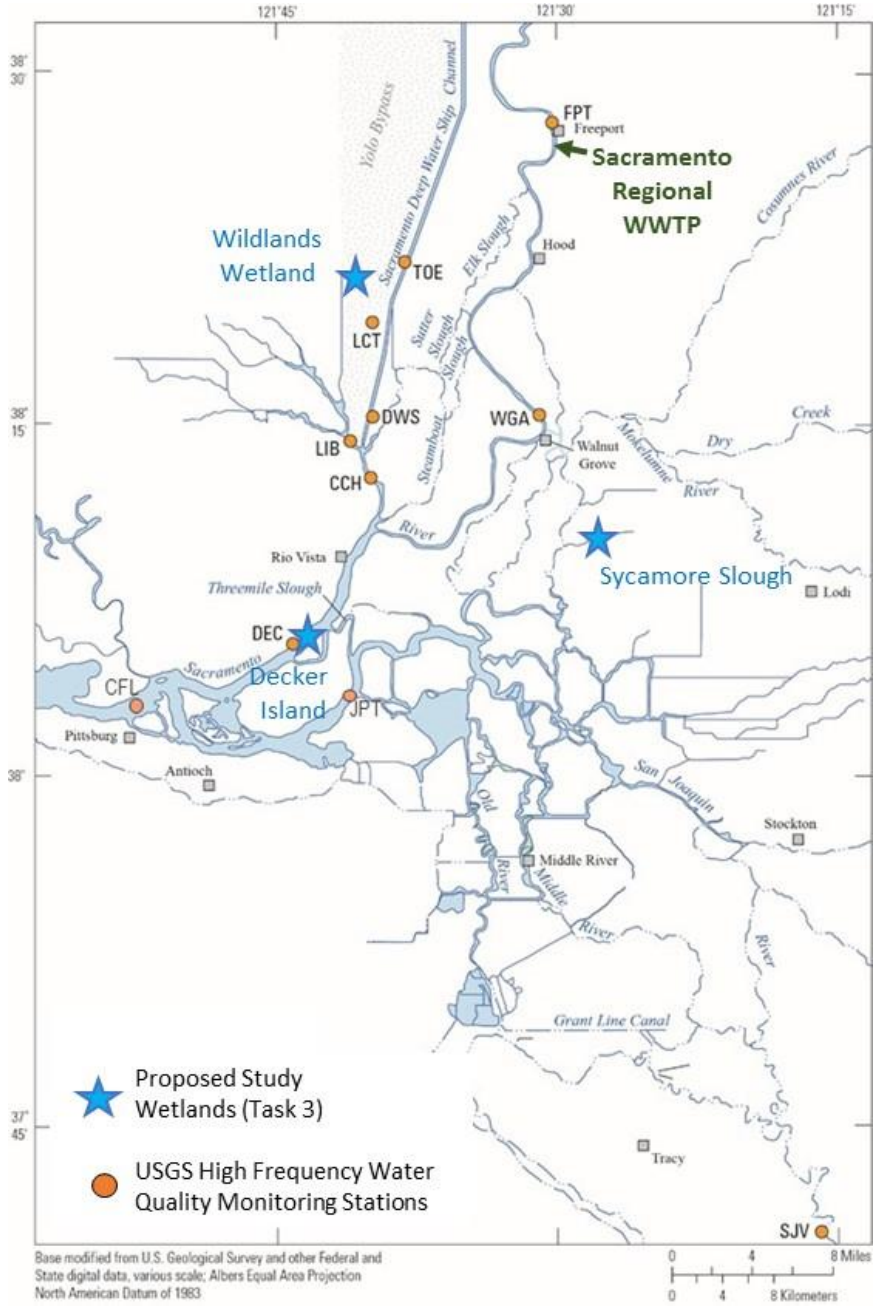


TIMESCALES OF NUTRIENT REACTIVITY AND RESPONSES





TASK 3: Developing tools for measuring nutrient transformation rates and effects in shallow wetlands

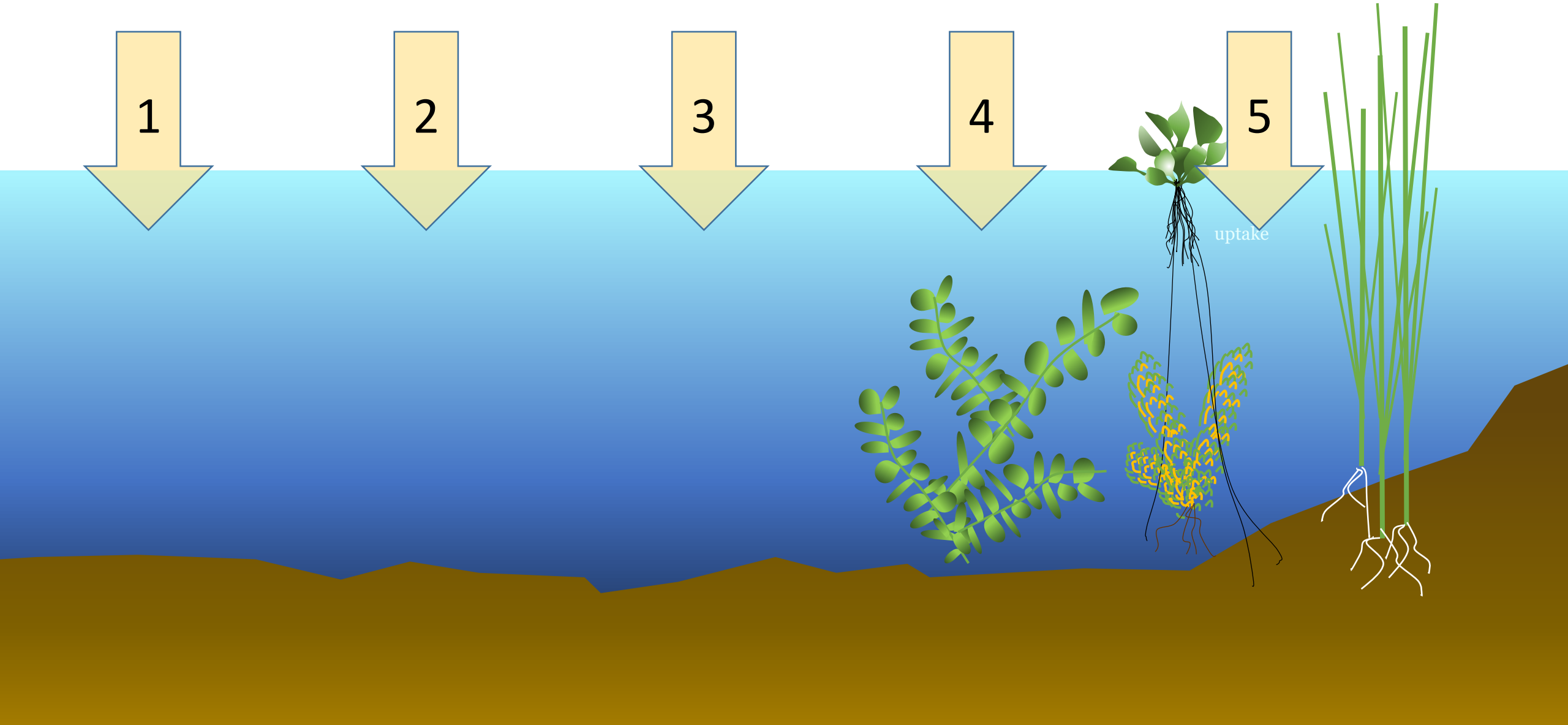
3 wetlands
Differ by ambient nutrient concentration
- Elevated Nitrate + Ammonium
- Elevated Nitrate
- Low Nitrate + Ammonium

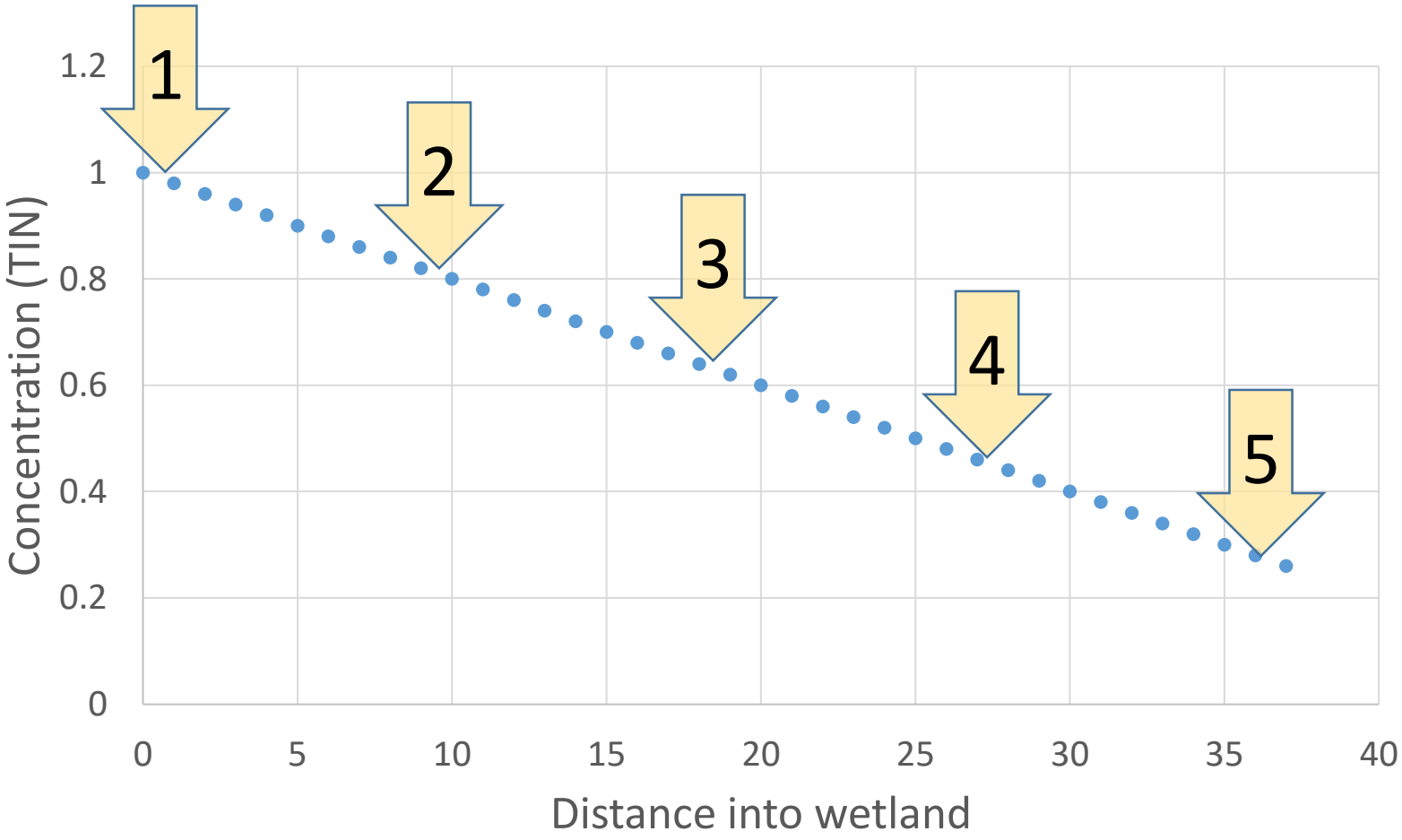
2-week studies in series
Starting in late spring

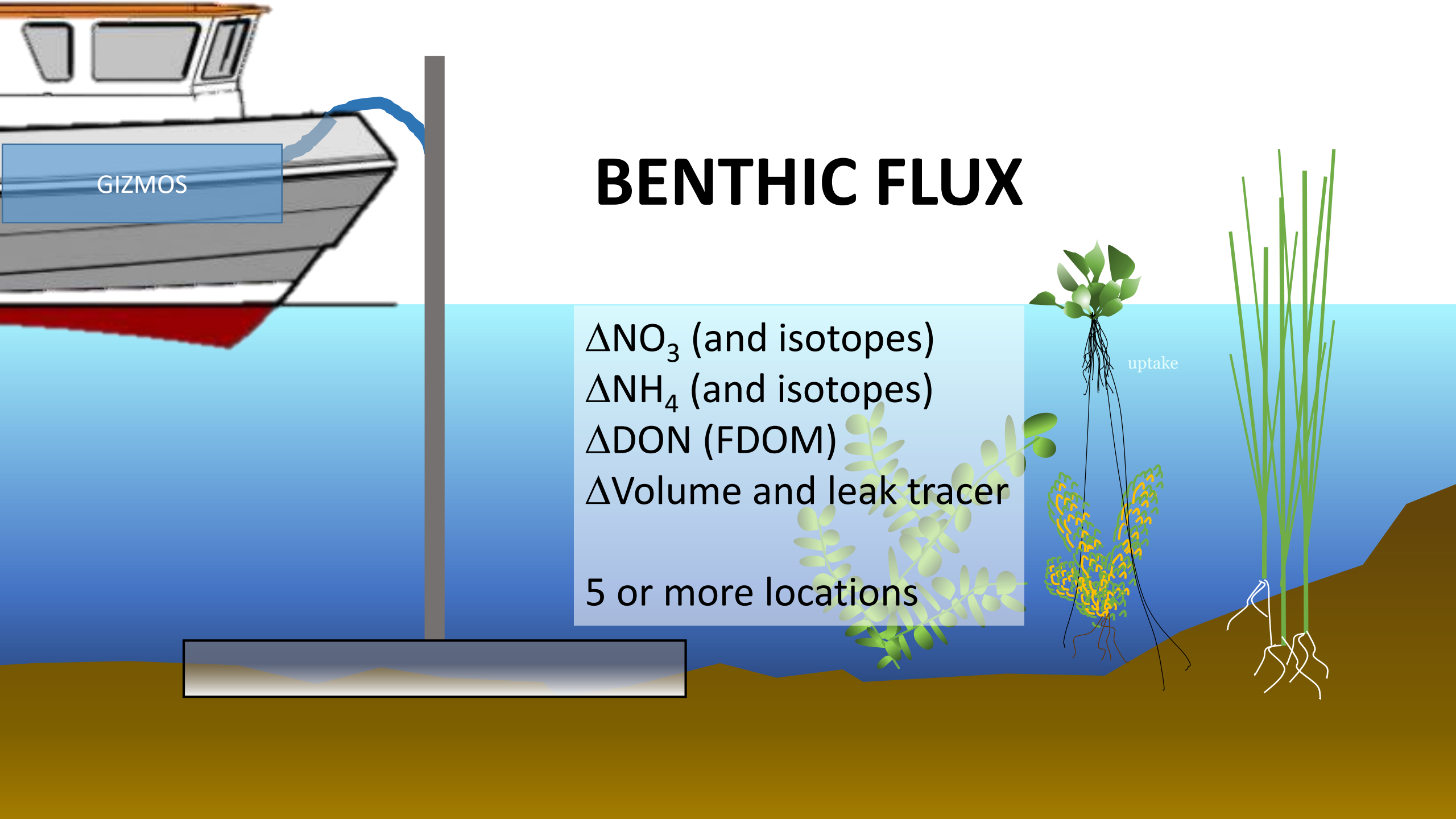
Chemical rates – Bergamaschi/Downing
Isotopic transformations – Kendall/Bergamaschi
Phytoplankton rates – Parker
Zooplankton rates – Kimmerer
Stable isotope signature of primary producers - Kraus/Kendall

NOT A COMPARISON BETWEEN WETLANDS

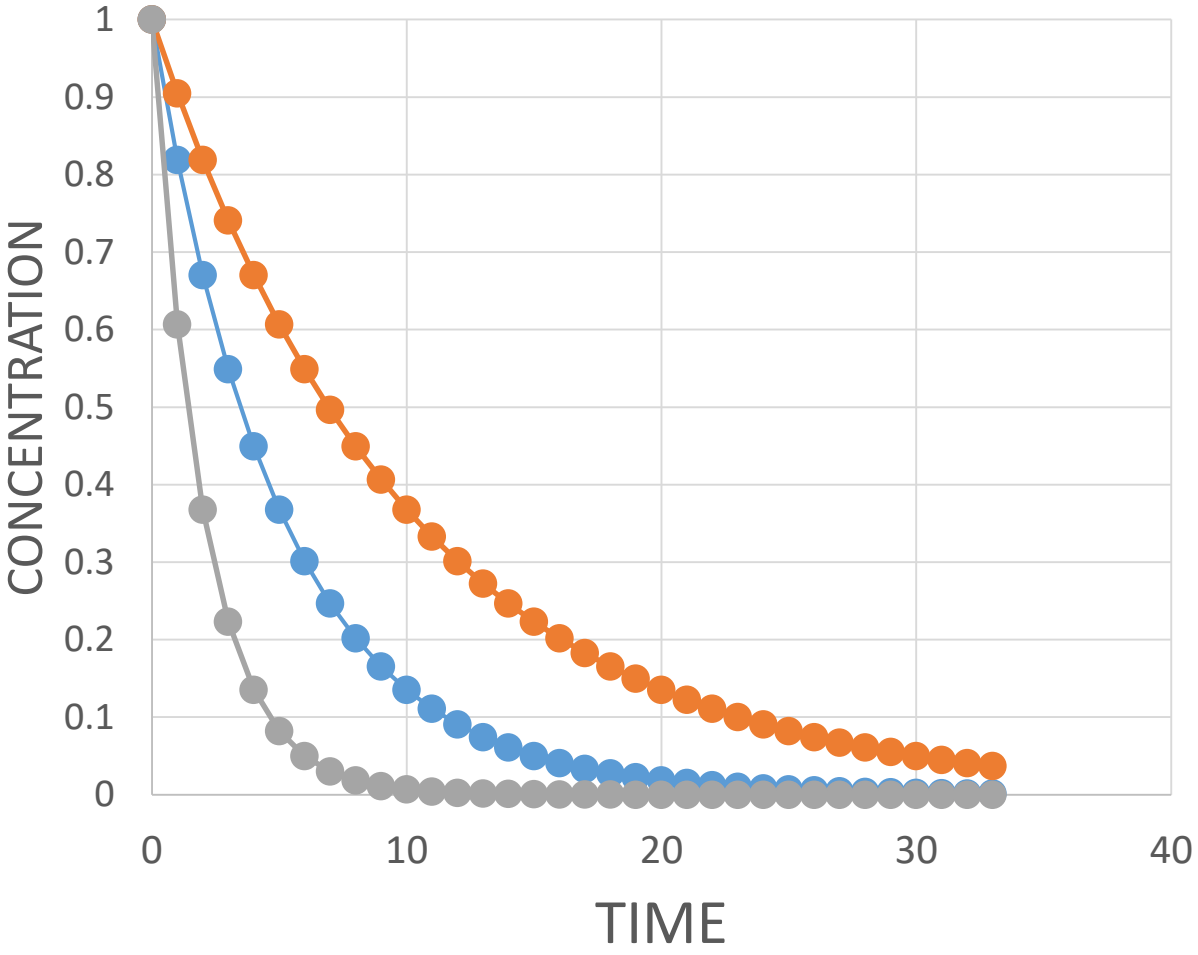
SPATIAL ASSESSMENT

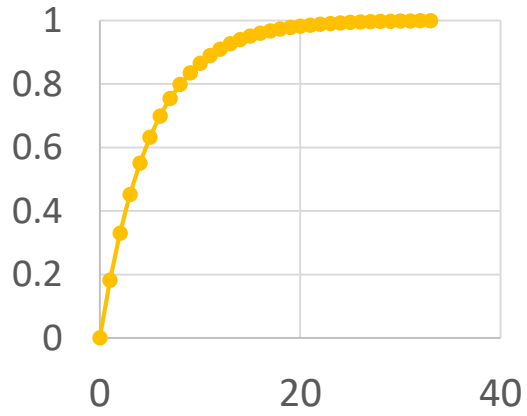


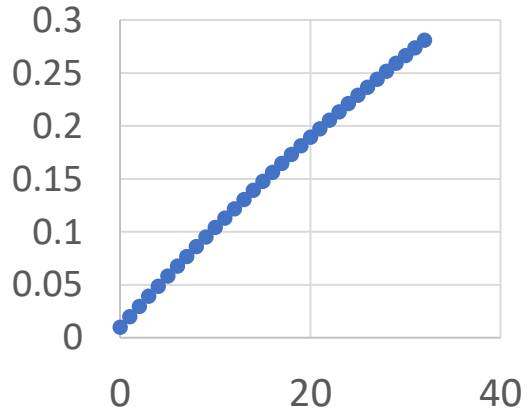

1
2
3
4
5
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (TIN)
0
5
10
15
20
25
30
35
40
Distance into wetland


GIZMOS
BENTHIC FLUX
ΔNO3 (and isotopes)
ΔNH4 (and isotopes)
ΔDON (FDOM)
ΔVolume and leak tracer
5 or more locations
uptake

Measure change in concentration over time

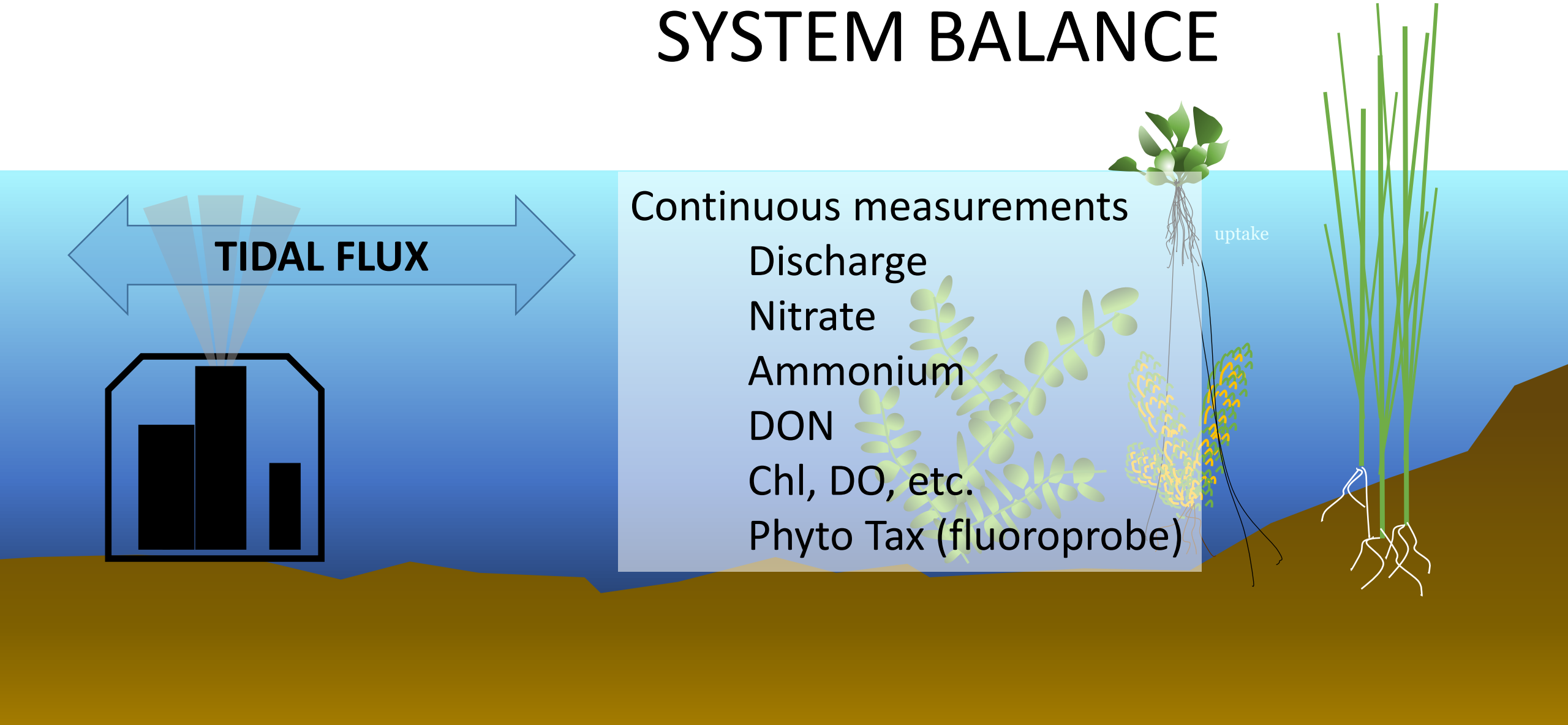






Advantage of onboard measurement is (a) know when you have the needed data; (b) know if chamber is sealed

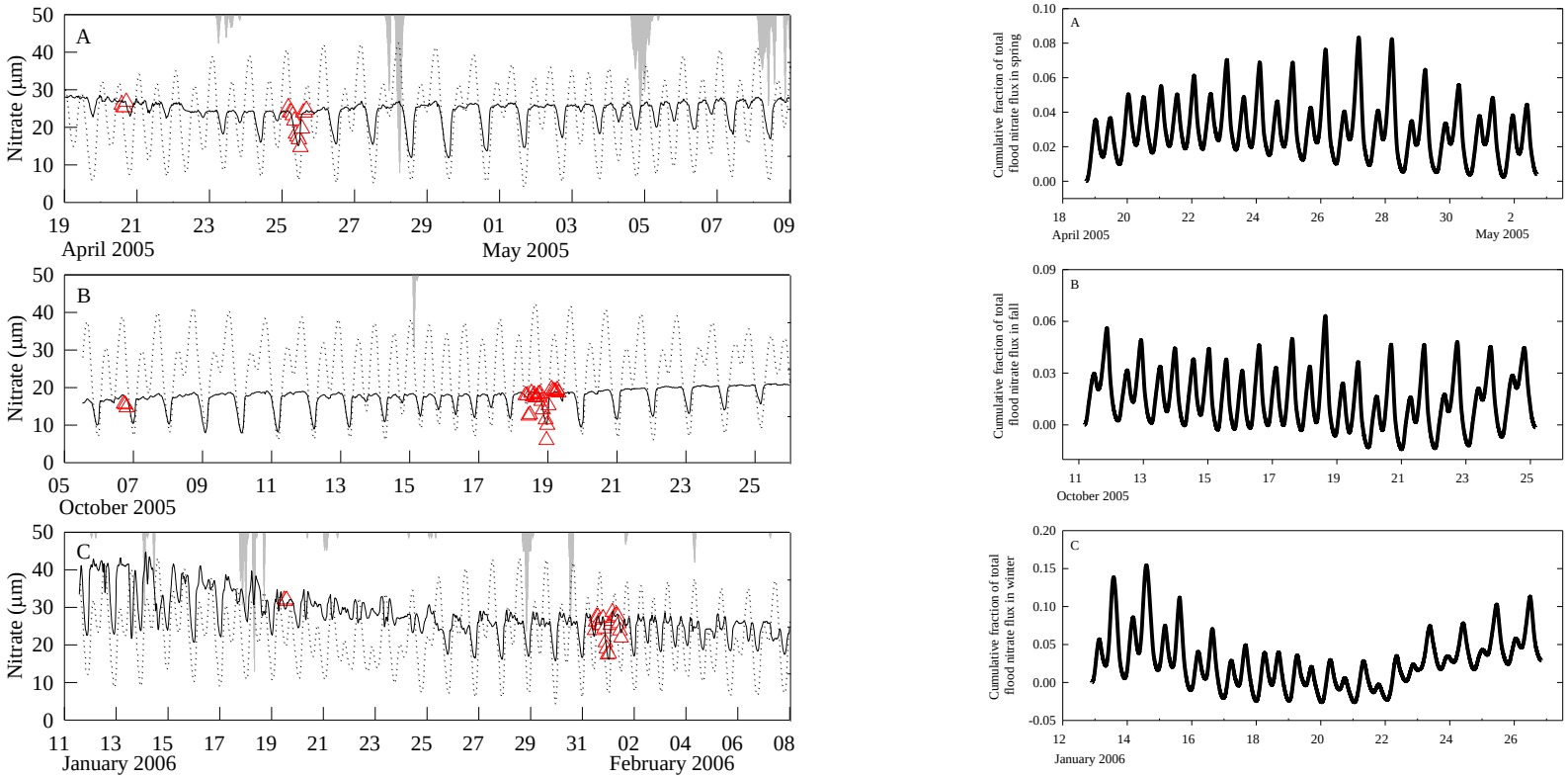
TIDAL FLUX SYSTEM BALANCE



Continuous measurements

- Discharge
- Nitrate
- Ammonium
- DON
- Chl, DO, etc.
- Phyto Tax (fluoroprobe)

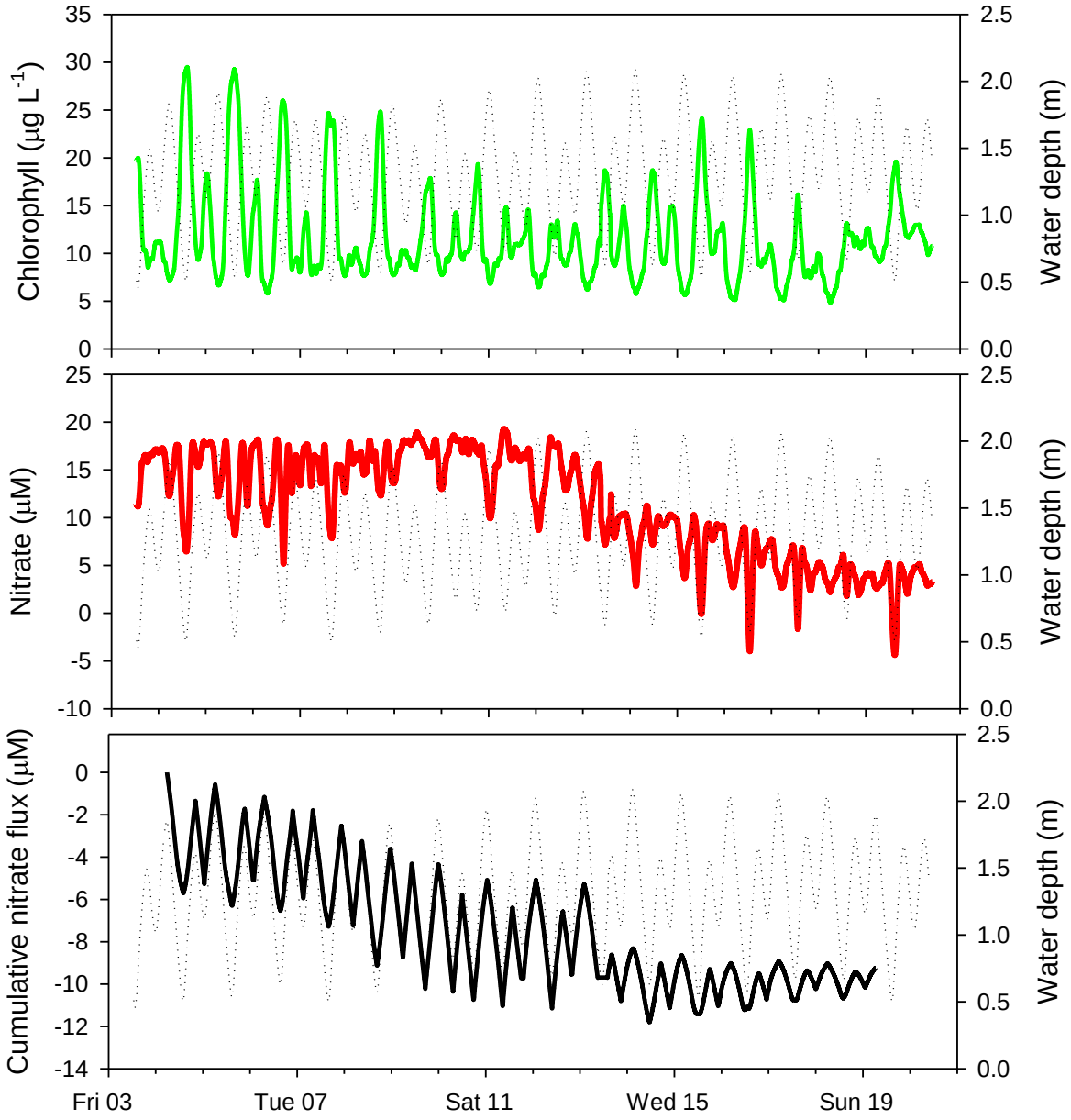
Tidal flux



Browns Island. Continuous concentration on left (with stage [dashed], precip [grey bars], and calibration samples [red symbols]). Cumulative flux on right. Cumulative flux over spring-neap cycle did not exceed uncertainty.

Tidal flux

Liberty Island wetland
San Francisco Estuary



Wetland consumes ~10% of nitrate influx over period of measurement

Summary

- GOAL: Develop tools to assess rates and effects
  - *Assessments will be preliminary*
  - *Continued assessment under a variety of conditions will be necessary*
- Using multiple overlapping assessment approaches
  - *Reduce measurement bias*
  - *Will ultimately pick the most promising/informative*
- Emphasis on integrative measurements rather than compartmentalized processes
  - *More appropriate for current modeling detail*
- Emphasis on tools useful over broader spatial and temporal scales
  - *Processes are variable over space and time*
  - *Processes interact in unpredictable ways*